

at any conclusion as to whether his species is a primary or secondary parasite of the Hessian fly.

Semiotellus (?) *nigripes* is a form which does not appear to have its representative in North America. It has a strong green, or sometimes blue, metallic lustre, the antennæ and legs black, the latter with greenish lustre, the tarsi pale yellow at the base. Length 2 millim. The species is widely distributed in Russia. It appears to be single-brooded, emerging in July and August.

Eupelmus Karschii is black with a green or blue lustre; antennæ black; legs yellow, with the tips of the femora and tibiæ and the last joint of the tarsi black. In the female the fore legs are entirely yellow. Length under 2 millim. The American species is recorded by Riley as a parasite of *Isosoma hordei* and *I. tritici*.

Platygaster minutus.—Length $\frac{1}{2}$ millim. Black, shining, but with no metallic lustre. Legs yellow, with black femora, and the posterior tibiæ black; wings large, extending far beyond the tip of the abdomen, veinless, but hairy; femora much thickened in the middle, tibiæ in their lower half. The species seems to be abundant. The author regards it, as also the much larger American *P. Herrickii*, as a direct parasite of the larva of the Hessian fly, and not as parasitic in the egg; he always reared it from the puparia, and obtained from four to eleven individuals from a single puparium.

Euryscapus saltator is wingless, black, with a green lustre on the head and thorax, and frequently a brownish spot on each side of the mesonotum. Abdomen black with a faint greenish lustre; legs yellow, with the femora, the middle of the tibiæ, and the tips of the tarsi rather darker; first segment of the abdomen reddish brown; ovipositor yellow with the tip black; scape yellowish brown; flagellum black or dark brown, with a greenish lustre on the first two joints. Length 2 millim. The author has bred this species from puparia of the Hessian fly and also from galls of *Isosoma hordei*, but it does not seem to be abundant.

A single specimen of a seventh species has been obtained by the author. It appears to be a *Platygaster* of about the same size as the one already noticed, black, with yellow legs and brown antennæ, which have a large black club; the wings are as in *Platygaster*.—*Bull. Soc. Imp. Nat. Moscou*, 1887, no. 1, pp. 178–192.

On the Power of Multiplication of the Infusoria Ciliata.

By M. E. MAUPAS.

The author notes that the power of multiplication of the Ciliata depends upon three factors, namely:—1, the quality and abundance of food; 2, temperature; 3, the biological adaptation of each species as regards alimentation. The third factor alone varies for each type, the organization of the buccal apparatus determining the kind of food necessary, and rendering the animalcules herbivorous, carnivorous, or omnivorous.

Cryptochilum, *Paramacium*, *Colpoda*, *Tillina*, *Colpidium*, and the Vorticellidæ are herbivorous, living almost exclusively upon Schizomycetes and small zoospores. These Infusoria are great purifiers of

foul water. A few *Paramecia* placed in a drop of water swarming with Bacteriæ, Vibrios, Bacilli, and other microbes will render it in a few hours as pure and clear as spring water. The Stentors, *Euplote*, and many Oxytrichidæ are omnivorous, and live upon Schizomycetes and small Infusoria drawn in by their vortices. *Enchelys*, *Didinium*, *Lacrymaria*, *Leucophrys*, the Trachelidæ, and *Coleps* are carnivorous, although some of them can feed upon Schizomycetes in the *Zoogloea*-state.

In small aquaria with infusions the species of Ciliata appear successively in a nearly constant order explicable by their peculiar alimentary adaptation. At first the herbivorous species, finding an abundance of Schizomycetes, swarm and clear the water of those microphytes. Then come the Carnivora, which pursue and exterminate the herbivorous forms.

Stylonychia pustulata has been particularly studied by the author, who followed day by day two separate cultures of it, during more than three hundred successive generations, which lasted rather more than eight months. Under the most favourable conditions of nutrition this species divides once in twenty-four hours at a temperature of 44°-50° F., twice at 50°-59°, three times at 59°-68°, four times at 68°-75°, and five times at 75°-80°. In the last case one individual will produce thirty-two in twenty-four hours; and thus at a temperature of 77°-79° F. a single *Stylonychia* may produce a million of descendants in four days, a billion in six days, and one hundred billions in seven and a half days. The author estimates that the body of a *Stylonychia* has a volume of 100,000 cubic micromillimetres; hence it would take ten thousand to make 1 cubic millim. and a million to 1 cubic centim. Protoplasm being about equal in density to water, a million *Stylonychie* will weigh 1 gram, a billion 1 kilogr., and one hundred billions 100 kilogr. Thus a single *Stylonychia* may produce 1 kilogramme of protoplasm in six days and 100 kilogrammes in seven and a half days.

These numbers are obtained when the *Stylonychie* are abundantly nourished with small Infusoria, but with vegetable food the rapidity of multiplication and the size of the animals are considerably reduced.

Stylonychia mytilus has less power of multiplication than *S. pustulata*. At a temperature of 42°-48° it divides only once in two days, at 50°-57° once a day, at 59°-64° twice, and three times at 66°-77°.

Euplotes patella requires a temperature of 59°-68° to divide once, and of 68°-75° to divide twice in twenty-four hours. *Oxychodromus grandis* divides once in two days at 41°-44°, once a day at 48°-53°, and twice at 55°-64°. *Oxytricha fallax* twice at 57°-61°, and three times at 62°-64°. *Stentor ceruleus*, of which the fission was observed for a month, divides once a day at 75°-79°; and *Spirostomum teres* once in two days at 61°-64°.

Paramæcium aurelia divides once in twenty-four hours at 57°-62°, and twice at 64°-68°; *Paramæcium caudatum* once at 59°-63°; and *Paramæcium bursaria* once in two or three days at 55°-59°.

Leucophrys patula, which is exclusively carnivorous, divides once in twenty-four hours at 43°–45°, twice at 46°–52°, three times at 54°–57°, four times at 59°–64°, and five times at 66°–68°; *Colpidium colpoda* twice at 54°–57°, three times at 59°–68°; *Coleps hirtus* once at 61°–64°; *Loxophyllum fasciola* twice at 59°–63°; *Spathidium hyalinum* once at 61°–63°, and twice at 63°–66°; an undetermined *Vorticella* once at 57°–61°.

Glaucoma scintillans, *Stylonychia pustulata*, *Colpidium colpoda*, and *Paramæcium bursaria*, kept in complete darkness for a month, multiplied exactly like those exposed to light.—*Comptes Rendus*, April 4, 1887, p. 1006.

On the Relations of the Groups of Arthropoda.

By Prof. CARL CLAUS.

In our number for March 1887, when printing Prof. Lankester's "Last Words on Professor Claus," we stated that the discussion on the matters in dispute must cease. We have since received from Prof. Claus a copy of an article on the subject in question published by him in the 'Arbeiten aus dem Zoologischen Institut der Universität Wien' (Band vii. Heft 2), in which he gives an exposition of his own views, with a request that a translation of this part should appear in the 'Annals,' for comparison with the conclusions formulated by Prof. Lankester in the article above cited. The "essential points" upon which Prof. Claus insists are stated by him as follows:—

"1. The opinion, according to which the Scorpions, and consequently the Arachnoidea, are to be derived phylogenetically from the Gigantostrea, was independently supported by me, following Huxley, as much as eleven years ago.

"2. The distinction of the three Arthropod series—1. Crustacea, s. str.; 2. Gigantostrea, Arachnoidea; 3. Myriopoda-Insecta—is implicitly contained in the passages cited of my Text-book (1880).

"3. My views as to the relation of *Limulus* to the Arachnoidea are quite different from the conception which is supported by Ray Lankester in 1881 in his *Limulus*-article.

"4. The reference of the Mites to retrograde Arachnoidea, which is supported by the discovery of the rudimentary heart, is self-evident as a necessary consequence of the position laid down under § 1, and certainly does not date from Ray Lankester's expositions, but had been supported many years ago upon other grounds.

"5. The hypothesis of the 'adaptational shifting of the oral aperture,' invented by that author from the analogy of the shifting of the mouth in *Amphioxus*, and by which the interpretation of the præ-oral limbs of the Arthropoda, and consequently both pairs of antennæ in the Crustacea, is proved, is a perfectly untenable hypothesis.

"6. This hypothesis has nothing in common with the opinion, founded upon the conditions of innervation, that the second pair of antennæ of the Crustacea represents the foremost truncal members, while the first pair of antennæ, like the antennæ of Insects and Myriopoda, belongs to the præstomial part of the head."